Claim Amendments

1. (currently amended) A method, a sensor array that employs a parameter to induce a time-varying phase angle φ on an optical signal that comprises a phase generated carrier with a demodulation phase offset β, the method comprising the steps of:

filtering an output signal from the sensor array to create a filtered signal; and

calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the filtered signal.

2. (currently amended) The method of claim 1, further comprising the step of:

sampling an output signal from the sensor array to obtain a plurality of samples S_n, wherein n = 0 to x;

wherein the step of calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the filtered signal comprises the step of:

calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of one or more of the plurality of samples S_n.

3. (currently amended) The method of claim ~~1~~ 2, wherein the step of calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises the steps of:

calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β; and

calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

4. (original) The method of claim 2, wherein the output signal comprises a period T_{pulse}, wherein the step of sampling the output signal from the sensor array to obtain the plurality of samples S_n, wherein $n = 0$ to x comprises the step of:

sampling the output signal from the sensor array to obtain a plurality of samples S_n within a period T_s, wherein $n = 0$ to x, wherein T_s is less than or equal to T_{pulse}.

5. (currently amended) The method of claim 4, wherein the step of calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises the steps of:

calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β;

calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

6. (original) The method of claim 5, wherein the step of calculating the one or more quadrature terms and the one or more in-phase terms through employment of the one or more of the plurality of samples S_n, wherein the one or more of the one or more quadrature terms and the one or more of the one or more in-phase terms are substantially independent of the demodulation phase offset β comprises the steps of:

calculating a set of quadrature terms Q_j and a set of in-phase terms I_k through employment of one or more of the plurality of samples S_n, wherein $j = 0$ to y, wherein $k = 0$ to z;

calculating a quadrature term $Q_s = \sqrt{\sum_{j=0}^{j=y} Q_j^2}$, wherein Q_s is substantially independent of the demodulation phase offset β;

calculating an in-phase term $I_s = C_1 \times \sqrt{\sum_{k=0}^{k=z} I_k^2}$, wherein I_s is substantially independent of the demodulation phase offset β; and

calculating the constant C_1 such that a maximum magnitude of the quadrature term Q_s and a maximum magnitude of the in-phase term I_s comprise a substantially same magnitude for a modulation depth M of an operating range for the phase generated carrier.

7. (original) The method of claim 6, wherein $x = 7$, $y = 3$, $z = 1$, wherein the step of calculating the set of quadrature terms Q_j and the set of in-phase terms I_k through employment of the one or more of the plurality of samples S_n, wherein $j = 0$ to y, wherein $k = 0$ to z comprises the steps of:

calculating $Q_0 = S_0 - S_4$;

calculating $Q_1 = S_1 - S_5$;

calculating $Q_2 = S_2 - S_6$;

calculating $Q_3 = S_3 - S_7$;

calculating $I_0 = (S_0 + S_4) - (S_2 + S_6)$; and

calculating $I_1 = (S_1 + S_5) - (S_3 + S_7)$.

8. (currently amended) The method of claim 6, wherein $x = 15$, $y = 7$, $z = 3$, wherein the step of calculating the set of quadrature terms Q_j and the set of in-phase terms I_k through employment of the one or more of the plurality of samples S_n, wherein $j = 0$ to y, wherein $k = 0$ to z comprises the steps of:

calculating $Q_0 = S_0 - S_8$;

calculating $Q_1 = S_1 - S_9$;

calculating $Q_2 = S_2 - S_{10}$;

calculating $Q_3 = S_3 - S_{11}$;

calculating $Q_4 = S_4 - S_{12}$;

calculating $Q_5 = S_5 - S_{13}$;

calculating $Q_6 = S_6 - S_{14}$;

calculating $Q_7 = S_7 - S_{15}$;

calculating $I_0 = (S_0 + S_8) - (S_4 + S_{12})$;

calculating $I_1 = (S_1 + S_9) - (S_5 + S_{13})$;

calculating $\cancel{I_0}$ $\underline{I_2} = (S_2 + S_{10}) - (S_6 + S_{14})$; and

calculating $\cancel{I_1}$ $\underline{I_3} = (S_3 + S_{11}) - (S_7 + S_{15})$.

9. (original) The method of claim 6, wherein the step of calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms comprises the steps of:

calculating a quadrature term Q from a magnitude of the quadrature term Q_s and one or more quadrature terms of the set of quadrature terms Q_j;

calculating an in-phase term I from a magnitude of the in-phase term I_s and one or more in-phase terms of the set of in-phase terms I_k; and

calculating the phase angle φ of the output signal from an arctangent of a quantity Q / I.

10. (currently amended) An apparatus, a sensor array that employs a parameter to induce a time-varying phase angle φ on an optical signal that comprises a phase generated carrier with a demodulation phase offset β, the apparatus comprising:

a filter component that filters an output signal from the sensor array to create a filtered signal; and

a processor component that employs the filtered signal to calculate the phase angle φ substantially independent from the demodulation phase offset β.

11. (currently amended) The apparatus of claim 10, wherein the processor component obtains a plurality of samples S_n of the filtered signal, wherein $n = 0$ to x;

wherein the processor component employs one or more of the plurality of samples S_n to calculate the phase angle φ substantially independent from the demodulation phase offset β.

12. (original) The apparatus of claim 11, wherein the processor component employs one or more of the plurality of samples S_n of the output signal to calculate one or more quadrature terms and one or more in-phase terms, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β of the phase generated carrier;

wherein the processor component employs the one or more quadrature terms and the one or more in-phase terms to calculate the phase angle φ.

13. (original) The apparatus of claim 11, wherein the output signal comprises a period T_{pulse}, wherein the processor component obtains the plurality of samples S_n within a period T_s, wherein T_s is less than or equal to T_{pulse}.

14. (original) The apparatus of claim 13, wherein the processor component employs one or more of the plurality of samples S_n of the output signal to calculate one or more quadrature terms and one or more in-phase terms, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β of the phase generated carrier;

wherein the processor component employs the one or more quadrature terms and the one or more in-phase terms to calculate the phase angle φ.

15. (original) The apparatus of claim 14, wherein the one or more of the one or more quadrature terms comprise a quadrature term Q_s, wherein the one or more of the one or more in-phase terms comprise an in-phase term I_s;

wherein the processor component employs one or more of the plurality of samples S_n, the quadrature term Q_s, and the in-phase term I_s to calculate the phase angle φ.

16. (original) The apparatus of claim 15, wherein the processor component employs the plurality of samples S_n to calculate a set of quadrature terms Q_j and a set of in-phase terms I_k, wherein $j = 0$ to y, wherein $k = 0$ to z;

wherein the processor component employs the set of quadrature terms Q_j and the set of in-phase terms I_k to calculate the quadrature term Q_s, and the in-phase term I_s.

17. (original) The apparatus of claim 16, wherein the processor component calculates a constant C_1, wherein the processor component calculates:

$$Q_s = \sqrt{\sum_{j=0}^{j=y} Q_j^2} \;;$$

wherein the processor component calculates:

$$I_s = C_1 \times \sqrt{\sum_{k=0}^{k=z} I_k^2} \;;$$

wherein the processor component calculates the constant C_1 such that a magnitude of the quadrature term Q_s and a magnitude of the in-phase term I_s comprise a substantially same magnitude at a modulation depth M of an operating range for the phase generated carrier.

18. (original) The apparatus of claim 17, wherein the processor component employs the quadrature term Q_s and the set of quadrature terms Q_j to calculate a quadrature term Q, wherein the processor component employs the in-phase term I_s and the set of in-phase terms I_k to calculate an in-phase term I;

wherein the processor component calculates:

$Q = \pm Q_s$;

wherein the processor component calculates:

$I = \pm I_s$;

wherein the processor component employs the set of quadrature terms Q_j to determine a sign of Q;

wherein the processor component employs the set of in-phase terms I_k to determine a sign of I;

wherein the processor component calculates:

$\varphi = \text{arctangent}\,(Q / I)$.

19. (original) The apparatus of claim 18, wherein $x = 7$, $y = 3$, and $z = 1$;

wherein the processor component calculates:

$Q_0 = S_0 - S_4$, $Q_1 = S_1 - S_5$, $Q_2 = S_2 - S_6$, and $Q_3 = S_3 - S_7$;

wherein the processor component calculates:

$I_0 = (S_0 + S_4) - (S_2 + S_6)$; and

$I_1 = (S_1 + S_5) - (S_3 + S_7)$.

20. (original) The apparatus of claim 18, wherein $x = 15$, $y = 7$, and $z = 3$;

wherein the processor component calculates:

$Q_0 = S_0 - S_8$, $Q_1 = S_1 - S_9$, $Q_2 = S_2 - S_{10}$, $Q_3 = S_3 - S_{11}$,

$Q_4 = S_4 - S_{12}$, $Q_5 = S_5 - S_{13}$, $Q_6 = S_6 - S_{14}$, and $Q_7 = S_7 - S_{15}$;

wherein the processor component calculates:

$I_0 = (S_0 + S_8) - (S_4 + S_{12})$, $I_1 = (S_1 + S_9) - (S_5 + S_{13})$,

$I_2 = (S_2 + S_{10}) - (S_6 + S_{14})$, and $I_3 = (S_3 + S_{11}) - (S_7 + S_{15})$.

21. (original) The apparatus of claim 10, wherein the period T_{pgc} of the phase generated carrier comprises a frequency f_{pgc} equal to $1 / T_{pgc}$, wherein the frequency f_{pgc} is approximately between 2 MHz and 20 MHz, wherein the phase generated carrier comprises a modulation depth M approximately between 1.0 radians and 1.7 radians, wherein the filter component comprises a 3dB roll-off frequency approximately between 10 MHz and 60 MHz.

22. (original) The apparatus of claim 21, wherein the filter component comprises a fourth order Bessel low-pass filter.

23. (original) The apparatus of claim 21, wherein the filter component comprises a fourth order real pole filter.

24. (currently amended) An article, a sensor array that employs a parameter to induce a time-varying phase angle φ on an optical signal that comprises a phase generated carrier with a demodulation phase offset β, the article comprising:

one or more computer-readable signal-bearing media;

means in the one or more media for filtering an output signal from the sensor array to create a filtered signal; and

means in the one or more media for calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the filtered signal.

25. (currently amended) The article of claim 24, further comprising:

means in the one or more media for sampling the filtered signal to obtain a plurality of samples S_n, wherein n = 0 to x;

wherein the means in the one or more media for calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the filtered signal comprises:

means in the one or more media for calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of one or more of the plurality of samples S_n.

26. (currently amended) The article of claim 25, wherein the means in the one or more media for calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises:

means in the one or more media for calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β; and

means in the one or more media for calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

27. (original) The article of claim 26, wherein the output signal comprises a period T_{pulse}, wherein the means in the one or more media for sampling the output signal from the sensor array to obtain the plurality of samples S_n, wherein $n = 0$ to x comprises:

means in the one or more media for sampling the output signal from the sensor array to obtain the plurality of samples S_n within a period T_s, wherein $n = 0$ to x , wherein T_s is less than or equal to T_{pulse}.

28. (currently amended) The article of claim 27, wherein the means in the one or more media for calculating the phase angle φ substantially independently of the demodulation phase offset β through employment of the one or more of the plurality of samples S_n comprises:

means in the one or more media for calculating one or more quadrature terms and one or more in-phase terms through employment of one or more of the plurality of samples S_n, wherein one or more of the one or more quadrature terms and one or more of the one or more in-phase terms are substantially independent from the demodulation phase offset β; and

means in the one or more media for calculating the phase angle φ through employment of the one or more quadrature terms and the one or more in-phase terms.

29. (new) The article of claim 28, wherein the means in the one or more media for calculating the one or more quadrature terms and the one or more in-phase terms through employment of the one or more of the plurality of samples S_n comprises:

means in the one or more media for calculating a set of quadrature terms Q_j and a set of in-phase terms I_k through employment of one or more of the plurality of samples S_n, wherein j = 0 to y, wherein k = 0 to z;

means in the one or more media for calculating a quadrature term $Q_s = \sqrt{\sum_{j=0}^{j=y} Q_j^2}$, wherein Q_s is substantially independent of the demodulation phase offset β;

means in the one or more media for calculating an in-phase term $I_s = C_1 \times \sqrt{\sum_{k=0}^{k=z} I_k^2}$, wherein I_s is substantially independent of the demodulation phase offset β; and

means in the one or more media for calculating the constant C_1 such that a maximum magnitude of the quadrature term Q_s and a maximum magnitude of the in-phase term I_s comprise a substantially same magnitude for a modulation depth M of an operating range for the phase generated carrier.

30. (new) The article of claim 29, further comprising:

means in the one or more media for employing the quadrature term Q_s and the set of quadrature terms Q_j to calculate a quadrature term $Q = \pm Q_s$;

means in the one or more media for employing the in-phase term I_s and the set of in-phase terms I_k to calculate an in-phase term $I = \pm I_s$;

means in the one or more media for employing the set of quadrature terms Q_j to determine a sign of Q;

means in the one or more media for employing the set of in-phase terms I_k to determine a sign of I;

means in the one or more media for calculating $\varphi = \text{arctangent} (Q / I)$.

31. (new) The article of claim 30, wherein x = 7, y = 3, and z = 1, the article further comprising:

means in the one or more media for calculating:

$Q_0 = S_0 - S_4$, $Q_1 = S_1 - S_5$, $Q_2 = S_2 - S_6$, and $Q_3 = S_3 - S_7$;

means in the one or more media for calculating:

$I_0 = (S_0 + S_4) - (S_2 + S_6)$; and

$I_1 = (S_1 + S_5) - (S_3 + S_7)$.

32. (new) The article of claim 30, wherein $x = 15$, $y = 7$, and $z = 3$, the article further comprising:

means in the one or more media for calculating:

$Q_0 = S_0 - S_8$, $Q_1 = S_1 - S_9$, $Q_2 = S_2 - S_{10}$, $Q_3 = S_3 - S_{11}$,

$Q_4 = S_4 - S_{12}$, $Q_5 = S_5 - S_{13}$, $Q_6 = S_6 - S_{14}$, and $Q_7 = S_7 - S_{15}$;

means in the one or more media for calculating:

$I_0 = (S_0 + S_8) - (S_4 \div S_{12})$, $I_1 = (S_1 + S_9) - (S_5 + S_{13})$,

$I_2 = (S_2 + S_{10}) - (S_6 + S_{14})$, and $I_3 = (S_3 + S_{11}) - (S_7 + S_{15})$.